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Title: File System for Creating Switched Logical I/O Paths for Fault Recovery (as amended)
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FIG. 1

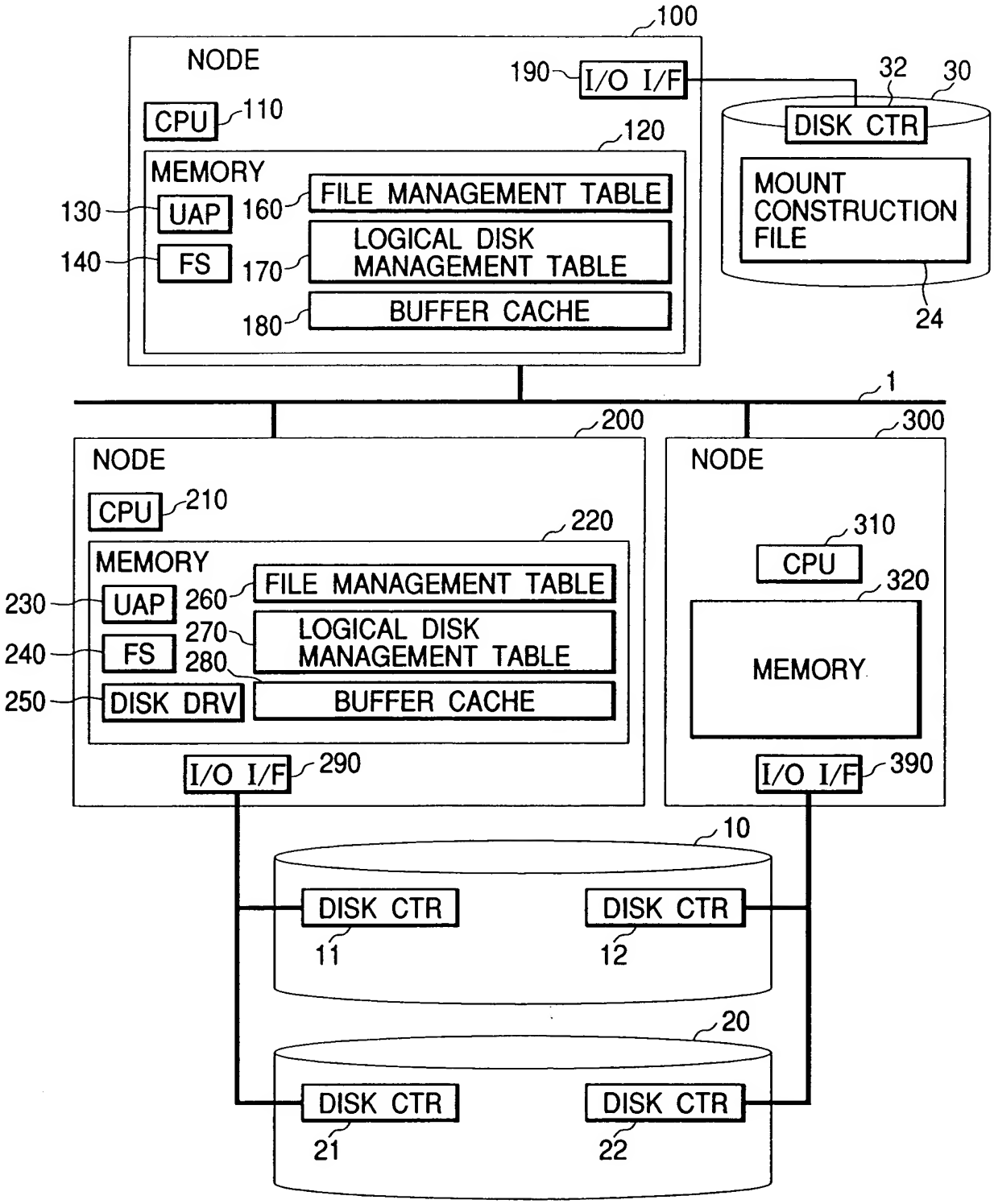

FIG. 2A

FILE MANAGEMENT TABLE 260(160)

| 261(161) FILE ID | 262(162) LOGICAL DISK ID | 263(163) FILE MANAGEMENT INFORMATION |
|---|---|---|
| 100 | 123 | 1999/12/10 128 BYTE ··· |
| 200 | 123 | 1999/12/12 500 BYTE ··· |

FIG. 2B

LOGICAL DISK MANAGEMENT TABLE 270(170)

| 271 (171) LOGICAL DISK ID | 272 (172) NODE NUMBER | 273 (173) I/O I/F NUMBER | 274 (174) DISK CTR NUMBER | 275 (175) STATUS FLAG | 276 (176) NODE NUMBER | 277 (177) I/O I/F NUMBER | 278 (178) DISK CTR NUMBER | 279 (179) STATUS FLAG |
|---|---|---|---|---|---|---|---|---|
| 123 | 200 | 290 | 11 | AVAILABLE | 300 | 390 | 12 | WAITING |

FIG. 2C

BUFFER CACHE 280

| 281 LOGICAL DISK ID | 282 BLOCK NUMBER | 283 CACHE DATA |
|---|---|---|
| 123 | 10 | XYZ |
| 123 | 11 | ABC |



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FIG. 3

MOUNT CONSTRUCTION FILE 24

MOUNT POINT ← COMMENT LINE

# ((NODE NUMBER, I/O I/F NUMBER, DISK CTR NUMBER) AVAILABILITY)

((200,290,11) AVAILABLE) 51 52

((300,390,12) AVAILABLE) 53 54 /mnt 55

FIG. 4

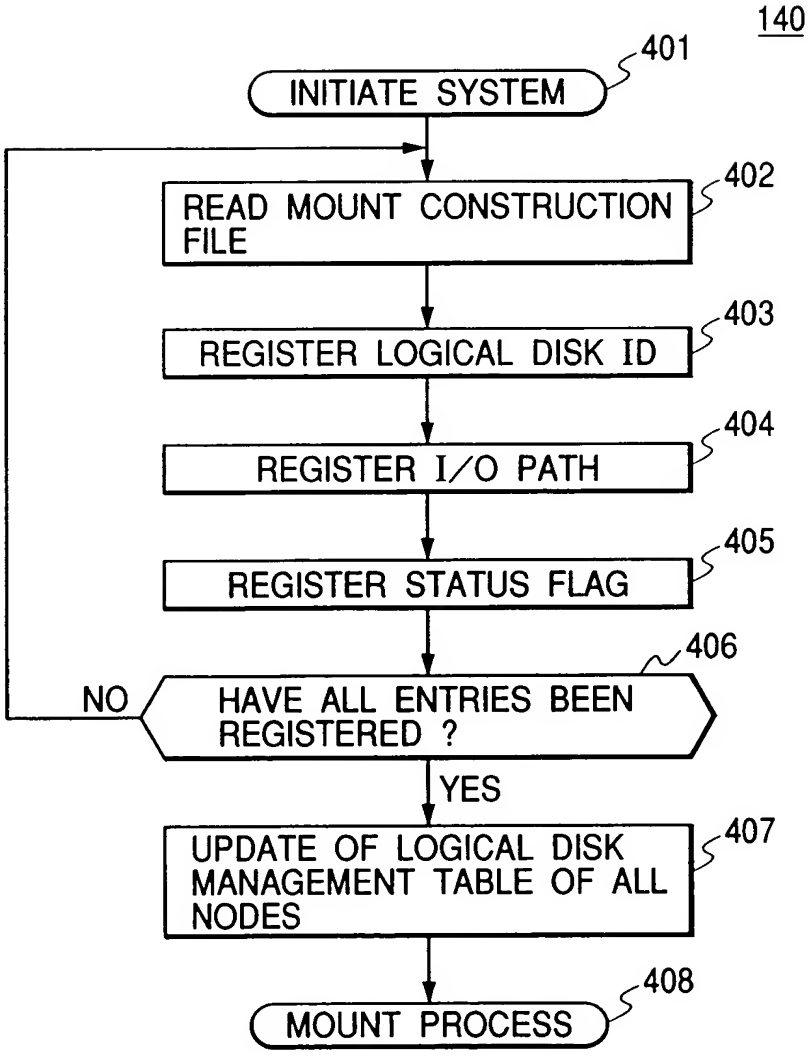

140
401
INITIATE SYSTEM
402
READ MOUNT CONSTRUCTION FILE
403
REGISTER LOGICAL DISK ID
404
REGISTER I/O PATH
405
REGISTER STATUS FLAG
406
HAVE ALL ENTRIES BEEN REGISTERED ?
NO
YES
407
UPDATE OF LOGICAL DISK MANAGEMENT TABLE OF ALL NODES
408
MOUNT PROCESS

FIG. 5

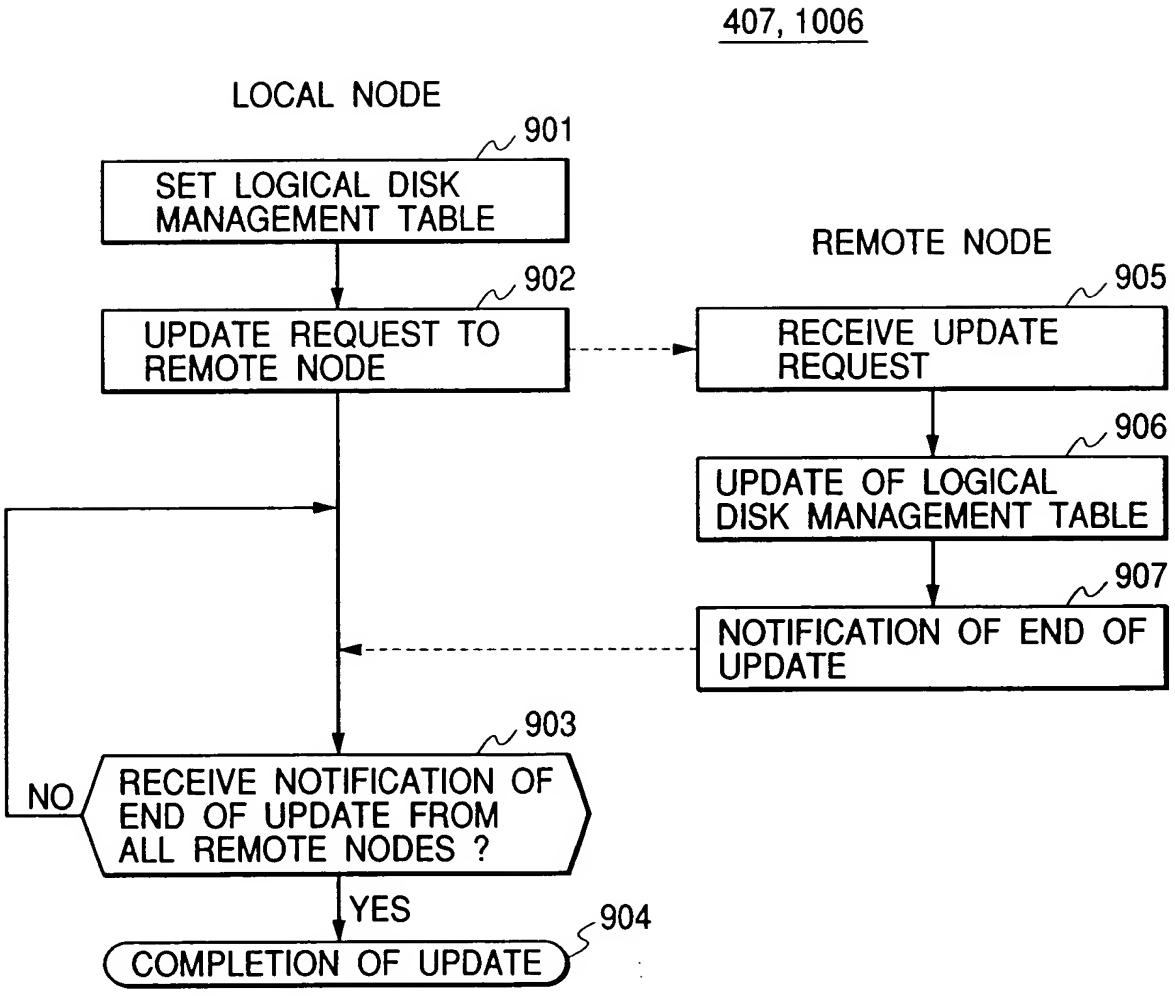

407, 1006
LOCAL NODE
901
SET LOGICAL DISK MANAGEMENT TABLE
902
UPDATE REQUEST TO REMOTE NODE
REMOTE NODE
905
RECEIVE UPDATE REQUEST
906
UPDATE OF LOGICAL DISK MANAGEMENT TABLE
907
NOTIFICATION OF END OF UPDATE
903
NO
RECEIVE NOTIFICATION OF END OF UPDATE FROM ALL REMOTE NODES ?
YES
904
COMPLETION OF UPDATE

FIG. 6

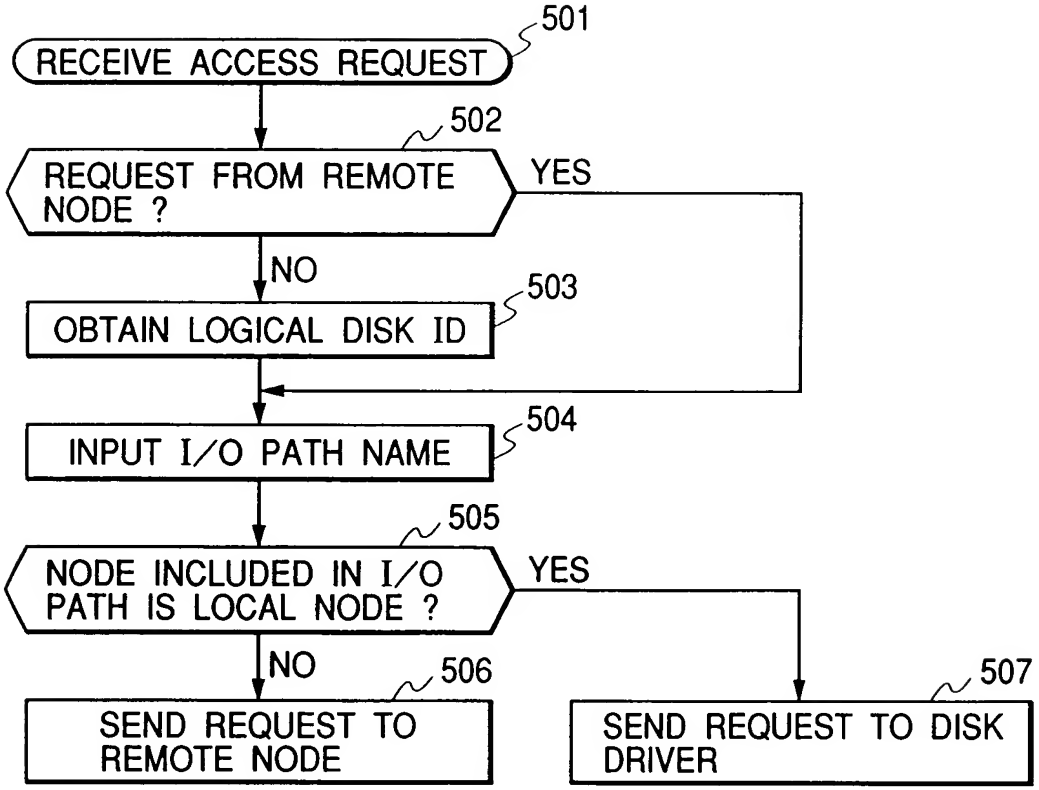

501
RECEIVE ACCESS REQUEST
502
REQUEST FROM REMOTE NODE ?
YES
NO
503
OBTAIN LOGICAL DISK ID
504
INPUT I/O PATH NAME
505
NODE INCLUDED IN I/O PATH IS LOCAL NODE ?
YES
NO
506
SEND REQUEST TO REMOTE NODE
507
SEND REQUEST TO DISK DRIVER

FIG. 7

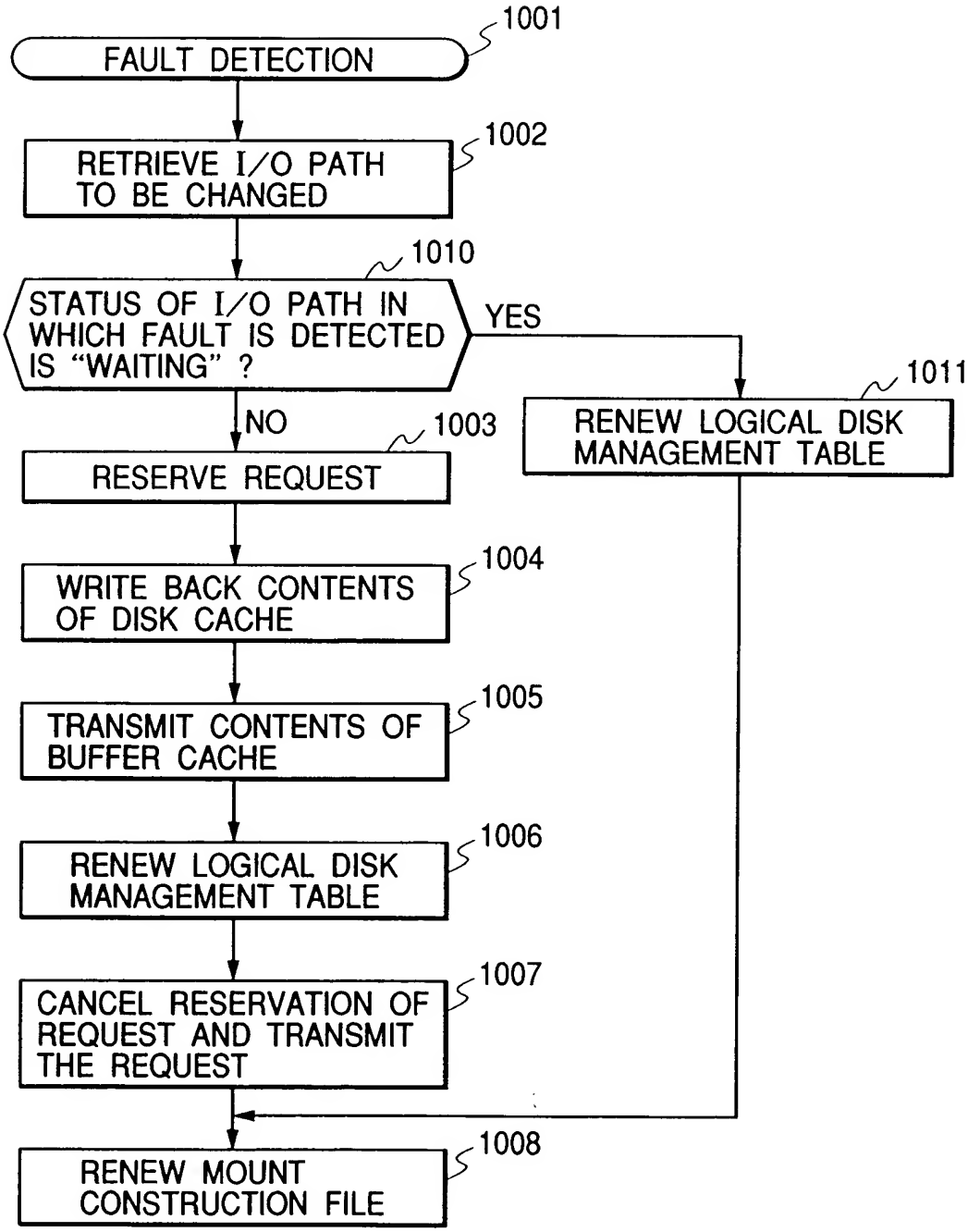

1001
FAULT DETECTION
1002
RETRIEVE I/O PATH TO BE CHANGED
1010
STATUS OF I/O PATH IN WHICH FAULT IS DETECTED IS "WAITING" ?
YES
NO
1011
RENEW LOGICAL DISK MANAGEMENT TABLE
1003
RESERVE REQUEST
1004
WRITE BACK CONTENTS OF DISK CACHE
1005
TRANSMIT CONTENTS OF BUFFER CACHE
1006
RENEW LOGICAL DISK MANAGEMENT TABLE
1007
CANCEL RESERVATION OF REQUEST AND TRANSMIT THE REQUEST
1008
RENEW MOUNT CONSTRUCTION FILE

FIG. 8

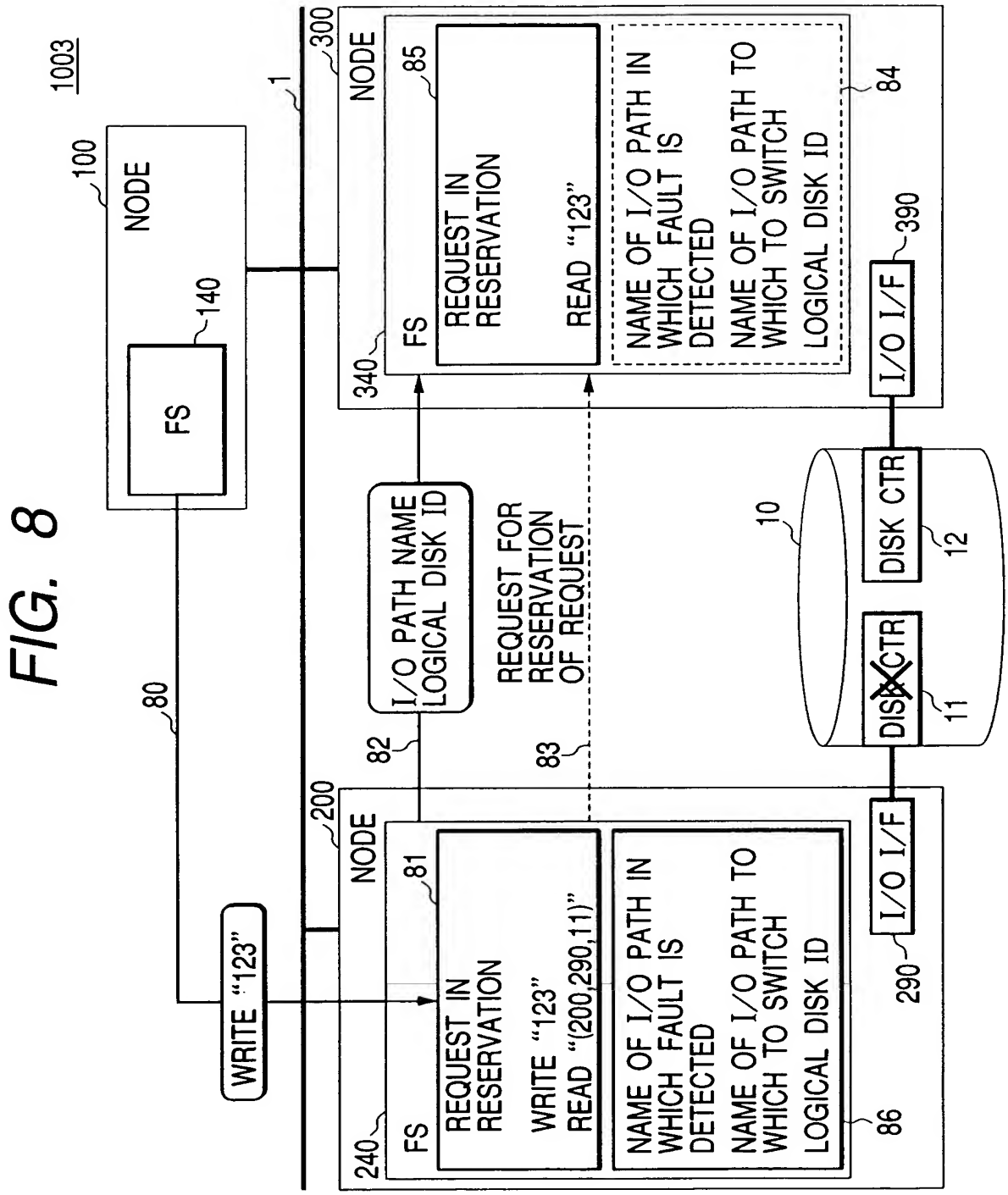

1003
100
NODE
FS
140
80
WRITE "123"
1
300
NODE
FS
340
REQUEST IN RESERVATION
READ "123"
85
NAME OF I/O PATH IN WHICH FAULT IS DETECTED
NAME OF I/O PATH TO WHICH TO SWITCH
LOGICAL DISK ID
84
I/O I/F
390
I/O PATH NAME
LOGICAL DISK ID
82
REQUEST FOR RESERVATION OF REQUEST
83
10
DISK CTR
12
DISK CTR
11
200
NODE
FS
240
REQUEST IN RESERVATION
WRITE "123"
READ "(200,290,11)"
81
NAME OF I/O PATH IN WHICH FAULT IS DETECTED
NAME OF I/O PATH TO WHICH TO SWITCH
LOGICAL DISK ID
86
I/O I/F
290

FIG. 9

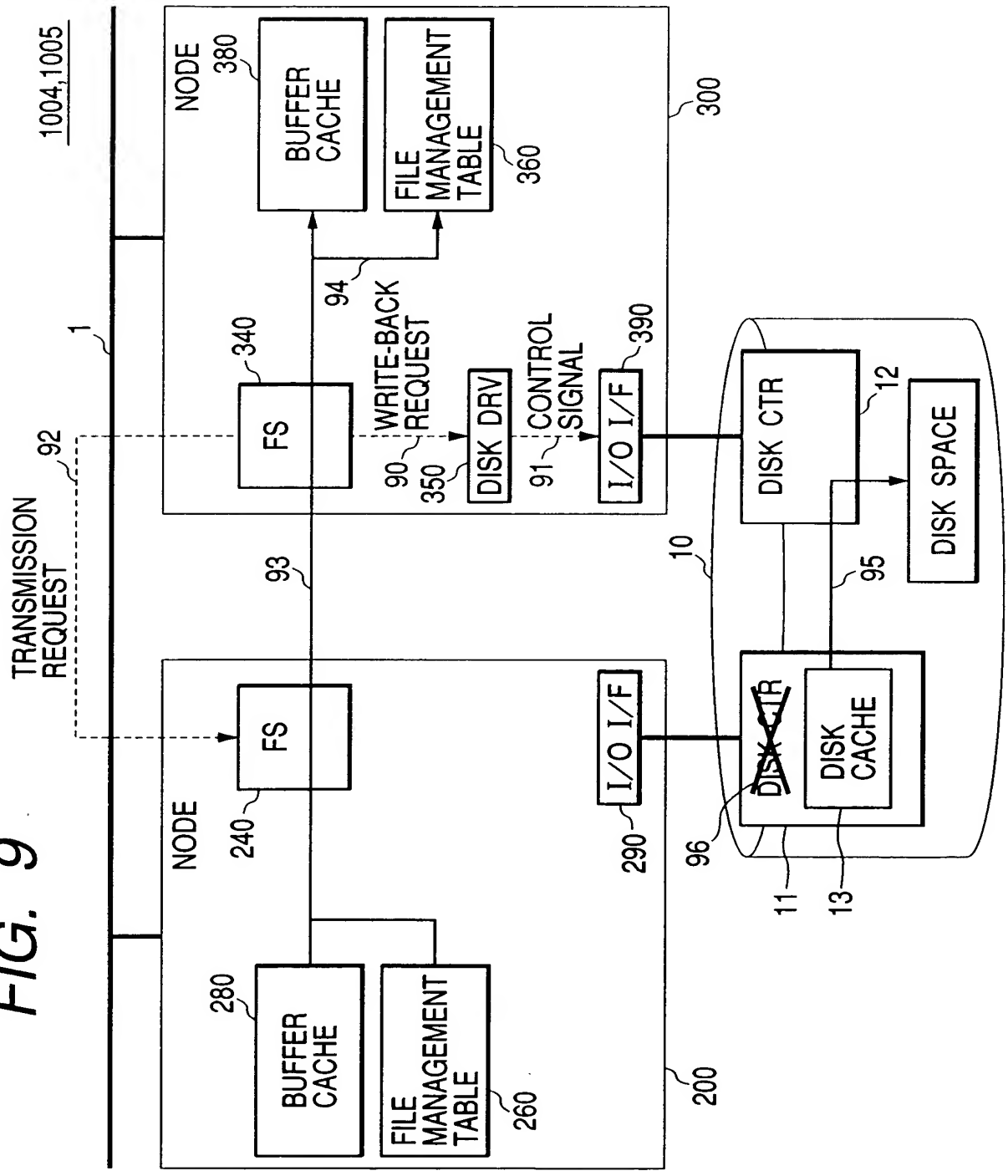

1004,1005
NODE
380
BUFFER CACHE
FILE MANAGEMENT TABLE
360
300
1
340
FS
WRITE-BACK REQUEST
94
90
350
DISK DRV
CONTROL SIGNAL
91
I/O I/F
390
92
TRANSMISSION REQUEST
93
10
DISK CTR
12
DISK SPACE
95
NODE
240
FS
290
I/O I/F
DISK CTR
DISK CACHE
96
11
13
280
BUFFER CACHE
FILE MANAGEMENT TABLE
260
200

FIG. 10

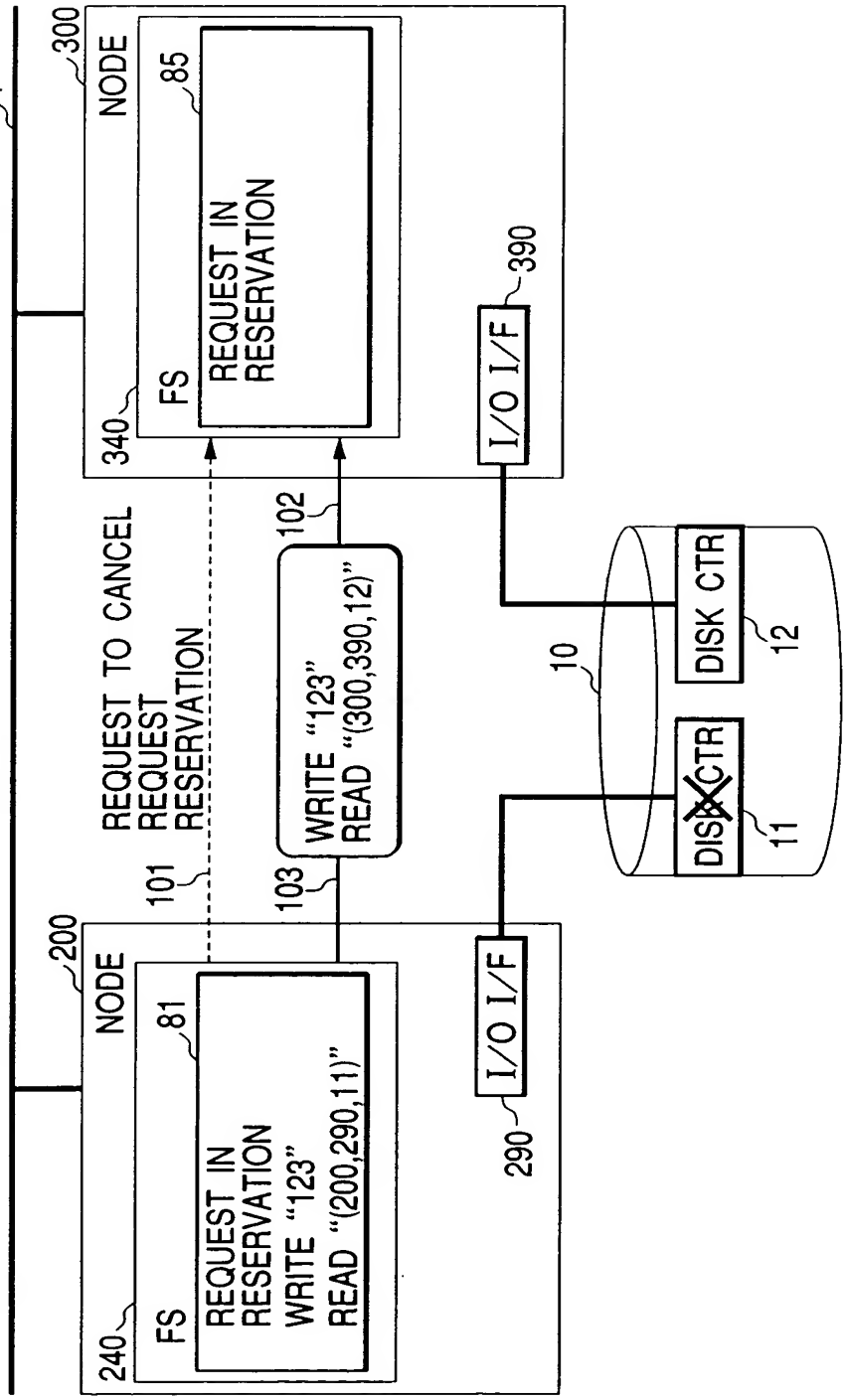

1007
1
300
NODE
85
REQUEST IN RESERVATION
FS
340
390
I/O I/F
REQUEST TO CANCEL
REQUEST
RESERVATION
101
102
WRITE "123"
READ "(300,390,12)"
103
10
DISK CTR
12
DISK CTR
11
200
NODE
81
REQUEST IN RESERVATION
WRITE "123"
READ "(200,290,11)"
FS
240
290
I/O I/F

FIG. 11

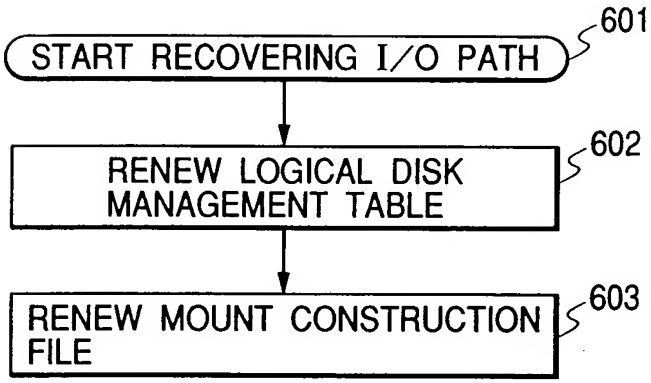

START RECOVERING I/O PATH
601
RENEW LOGICAL DISK MANAGEMENT TABLE
602
RENEW MOUNT CONSTRUCTION FILE
603

FIG. 12

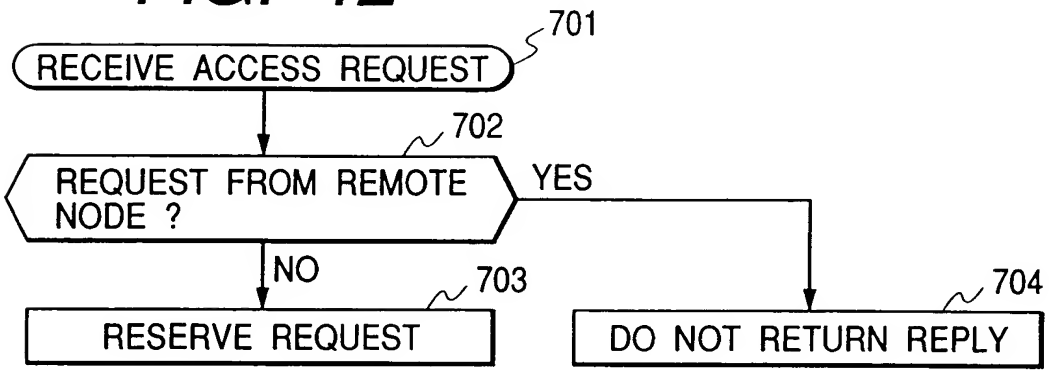

701
RECEIVE ACCESS REQUEST
702
REQUEST FROM REMOTE NODE ?
YES
NO
703
RESERVE REQUEST
704
DO NOT RETURN REPLY

FIG. 13

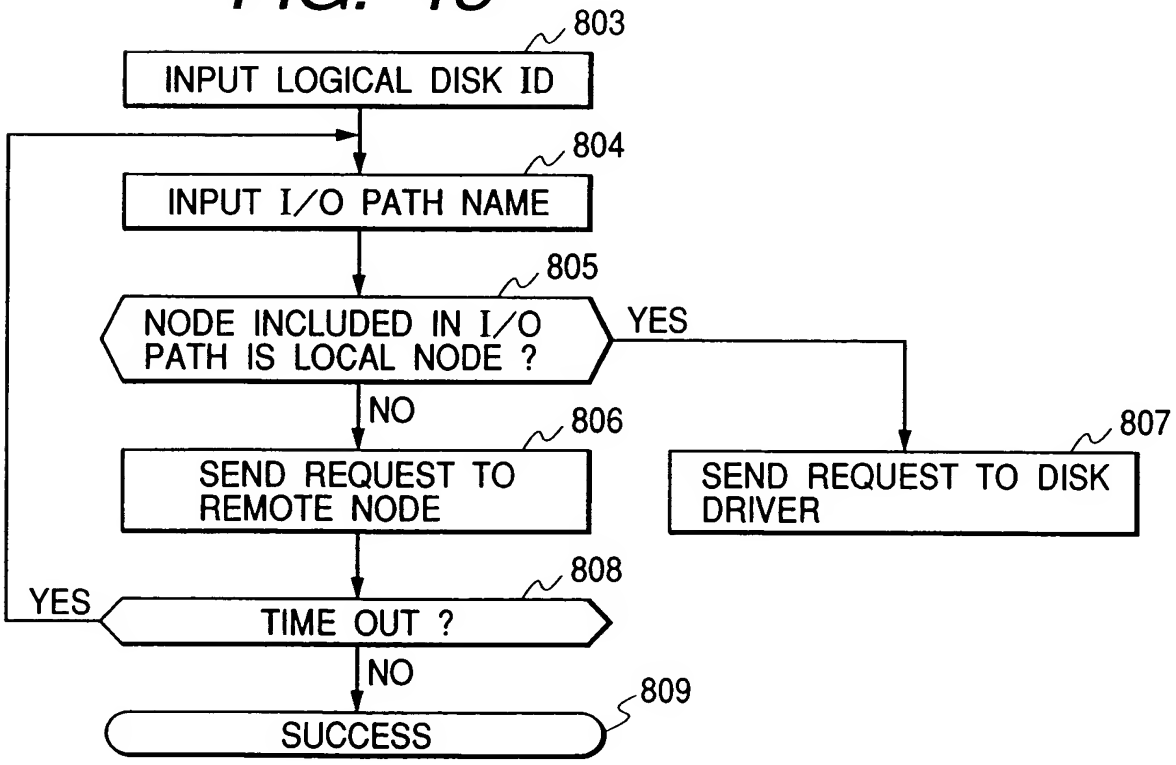

803
INPUT LOGICAL DISK ID
804
INPUT I/O PATH NAME
805
NODE INCLUDED IN I/O PATH IS LOCAL NODE ?
YES
NO
806
SEND REQUEST TO REMOTE NODE
807
SEND REQUEST TO DISK DRIVER
808
YES
TIME OUT ?
NO
809
SUCCESS

FIG. 14

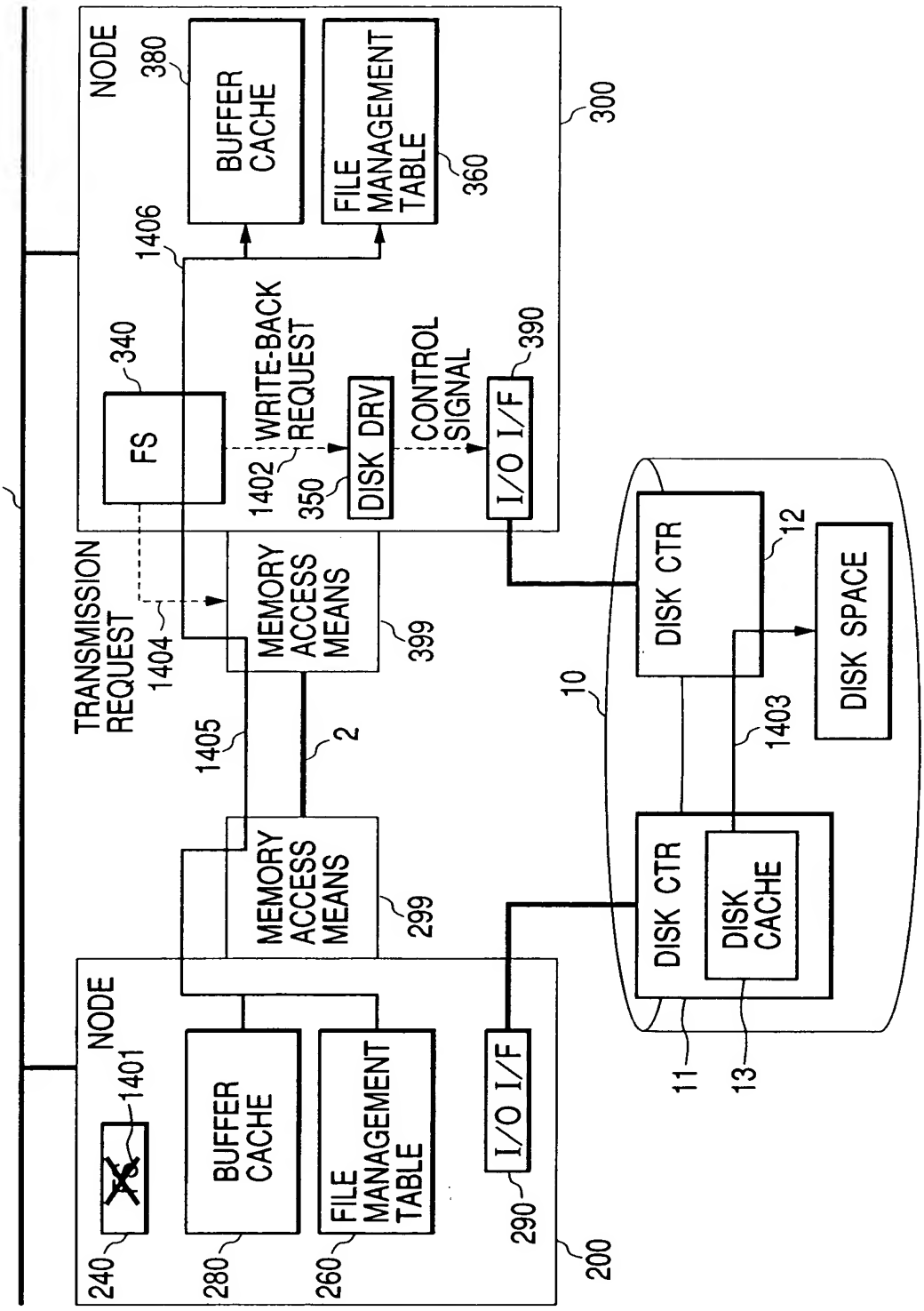
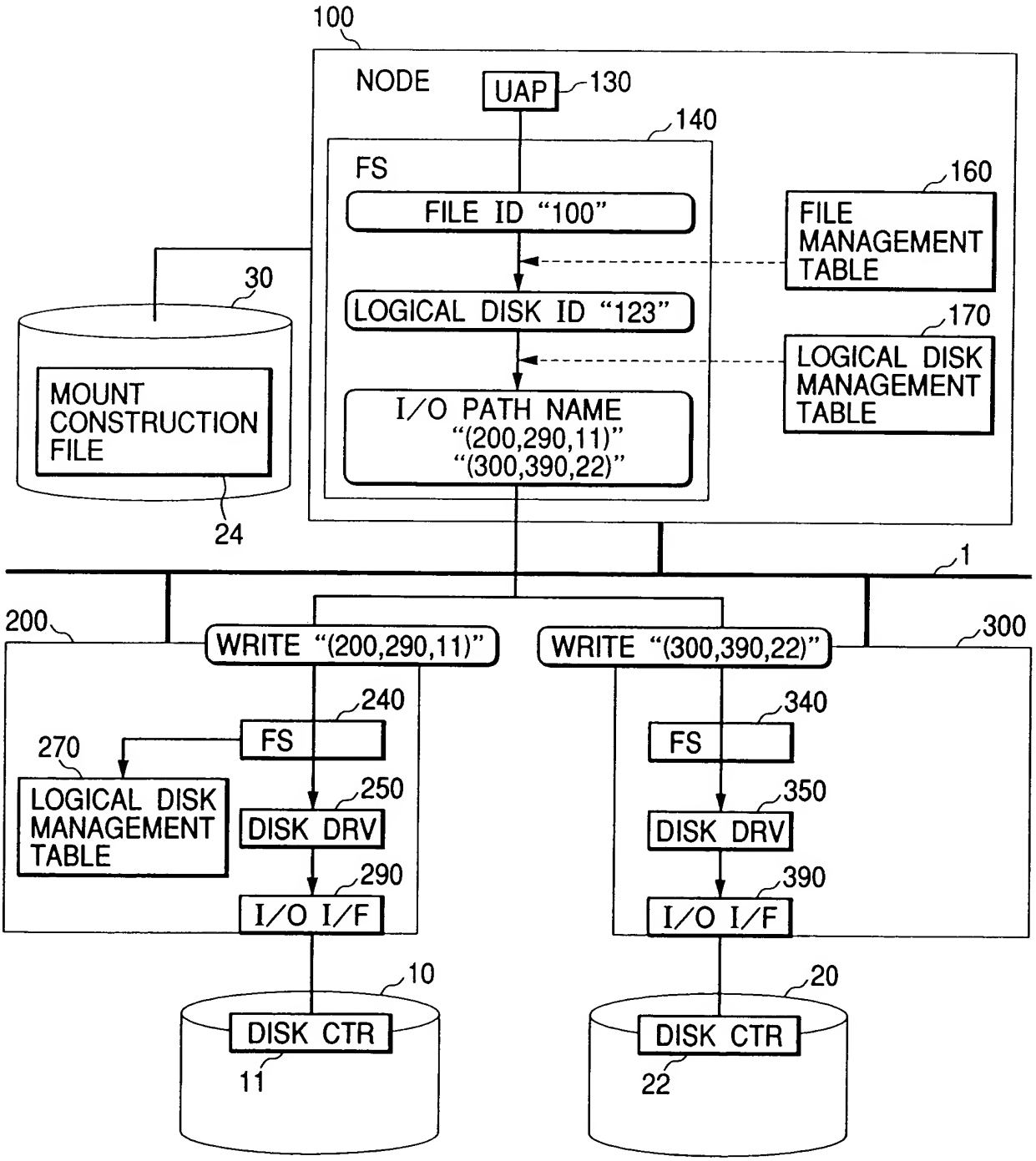

1004,1005
1
NODE
380
BUFFER CACHE
FILE MANAGEMENT TABLE
360
300
1406
340
FS
WRITE-BACK REQUEST
1402
350
DISK DRV
CONTROL SIGNAL
I/O I/F
390
TRANSMISSION REQUEST
1404
MEMORY ACCESS MEANS
399
1405
2
10
DISK CTR
12
DISK SPACE
1403
MEMORY ACCESS MEANS
299
DISK CTR
DISK CACHE
11
13
NODE
1401
BUFFER CACHE
FILE MANAGEMENT TABLE
I/O I/F
290
240
280
260
200

FIG. 15


100
NODE
UAP
130
140
FS
FILE ID "100"
160
FILE MANAGEMENT TABLE
30
LOGICAL DISK ID "123"
170
LOGICAL DISK MANAGEMENT TABLE
MOUNT CONSTRUCTION FILE
I/O PATH NAME "(200,290,11)" "(300,390,22)"
24
1
200
WRITE "(200,290,11)"
WRITE "(300,390,22)"
300
240
FS
340
FS
270
LOGICAL DISK MANAGEMENT TABLE
250
DISK DRV
350
DISK DRV
290
I/O I/F
390
I/O I/F
10
DISK CTR
11
20
DISK CTR
22

# FIG. 16A

MOUNT CONSTRUCTION FILE 24

# ((NODE NUMBER, I/O I/F NUMBER, DISK CTR NUMBER) AVAILABILITY)

MOUNT POINT ← COMMENT LINE

((200,290,11) AVAILABLE) ((300,390,22) AVAILABLE) /mnt

51 52 53 54 55

# FIG. 16B

LOGICAL DISK MANAGEMENT TABLE 270(170)

| 271 (171) LOGICAL DISK ID | 272 (172) NODE NUMBER | 273 (173) I/O I/F NUMBER | 274 (174) DISK CTR NUMBER | 275 (175) STATUS FLAG | 276 (176) NODE NUMBER | 277 (177) I/O I/F NUMBER | 278 (178) DISK CTR NUMBER | 279 (179) STATUS FLAG |
|---|---|---|---|---|---|---|---|---|
| 123 | 200 | 290 | 11 | AVAILABLE | 300 | 390 | 22 | AVAILABLE |



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